Deliverable D
Conceptual Design

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Table of contents

Introduction

This document is intended to identify the problems that will need to be resolved by the design of the final system. Furthermore, it is also used to collect and organize all possible solutions to each of the problems set out by either the customer, users, or us; the designers. Later, these proposed solutions will be combined and altered in order to produce a superior final product. In essence, the problems will be broken down into subsystems and each member will provide a possible solution to each of them. Finally, the team will come together in a meeting to decide which of the ideas will best identify each problem, or identify a combination of solutions to solve the issue.

Overall connection Plan (Andy):

It doesn't matter which type of sensor or any kind of parts we decide to use we will need an efficient way to manage the cable. Here is a simple sketch of wiring logic for the system;

Figure1 Overall planning
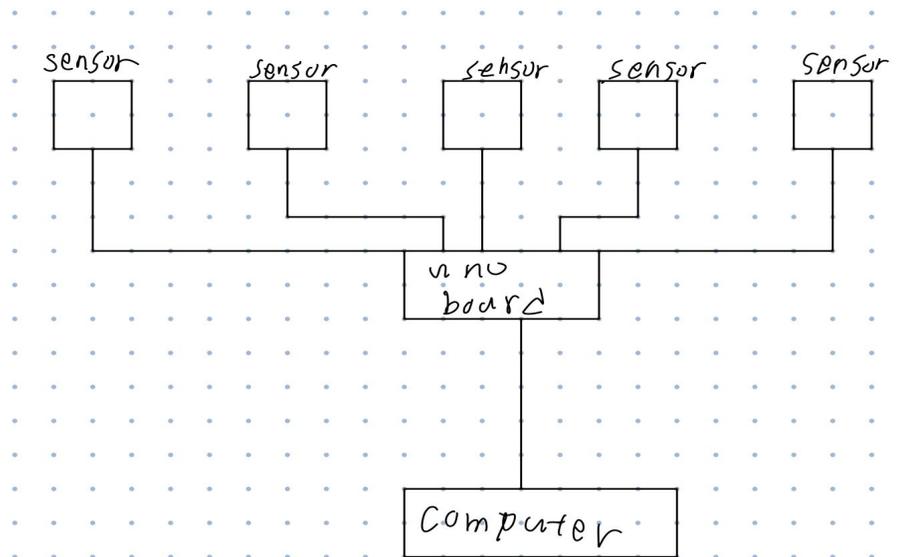
In order to make this plan work, we will need zip ties and the extension jump wire to connect the sensor to our Arduino UNO board. Then we can connect the Arduino UNO board to the computer with a USB cable.

Problem:
Sensor Design by Andy Dai and Brendan**:**

Based on previous research, the dashboard should satisfy the following functional needs:

1. Detect whether the 3D printer is ON or OFF.

2. The sensor should be safe to use and modify.

And should satisfy the following non-functional needs:

1. The sensor should determine how much time is required for said 3D printer to finish the current project.

Solution 1-Timer:

Allowing people using the interface to observe how much time is left on the print, keeps close to real-time. This will either be required to be entered by someone in the Makerspace at the time or will be taken automatically from the timer within the machine.

Solution 2-Motion Sensor:

The reason why choose the motion sensor is because it is one of the most popular sensors out there in the market. Additionally, since it is so popular we can find lots of code in online databases to control them and the price to buy them is very low. Even the Arduino UNO board has the exist program to support them. The following picture is the combination of the Arduino UNO board and the motion sensor.
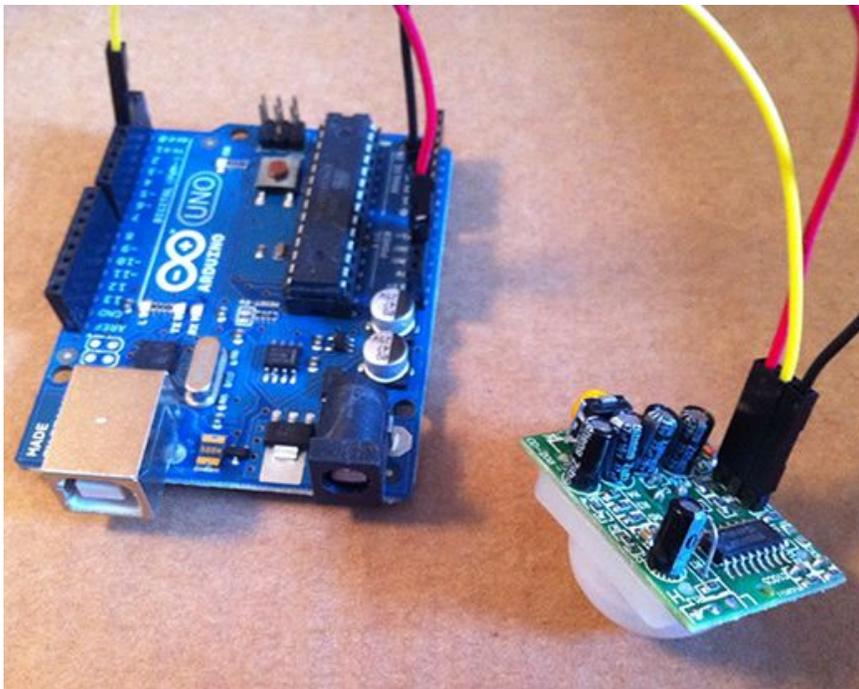
Figure 2 motion sensor with board

Solution 3-Camera:

A cheap camera can function as the sensor sensor which will provide us with the information we need. By placing a camera over the work station of the 3D printer we can determine whether the printer is ON/OFF and estimate the time remaining to finish the current

project. But the most difficult part to use this sensor is the way to handle the information from the camera and project to the Ross DashBoard.

Dashboard design by Juncheng Mo and Zehua Dang
Based on previous research, the dashboard should satisfy the following functional needs:

     1.Display the results from the timer and sensor properly
     2. The solution provides staff with an interface of the labs from anywhere
     3. The solution can remind users how much time is remaining in the day

And should satisfy the following non-functional needs:

     1. The User Interface is easy to understand.
     2. The User Interface is in English and French.
     3. The page is aesthetically pleasing.
   4. Users can find the icons corresponding to 3D printers easily.

Solution 1-Simply user interface
To make the UI easy to understand, it is always important to keep it simple. In this design, the results from the timers and sensors are displayed on one custom panel. There are read-only content and no link towards another custom panel. Essential information such as the state of the machine is displayed use bold colours and textures.

Stickers with numbers are stuck on the 3D printers in numerical order. In which way the users can easily match the icon in the dashboard with the real 3D printer.

The dashboard can display the current time and the opening hours of the station. At the end of the opening hour, the UI will warn the users who want to start a new 3D printing.

The following picture shows as an example:
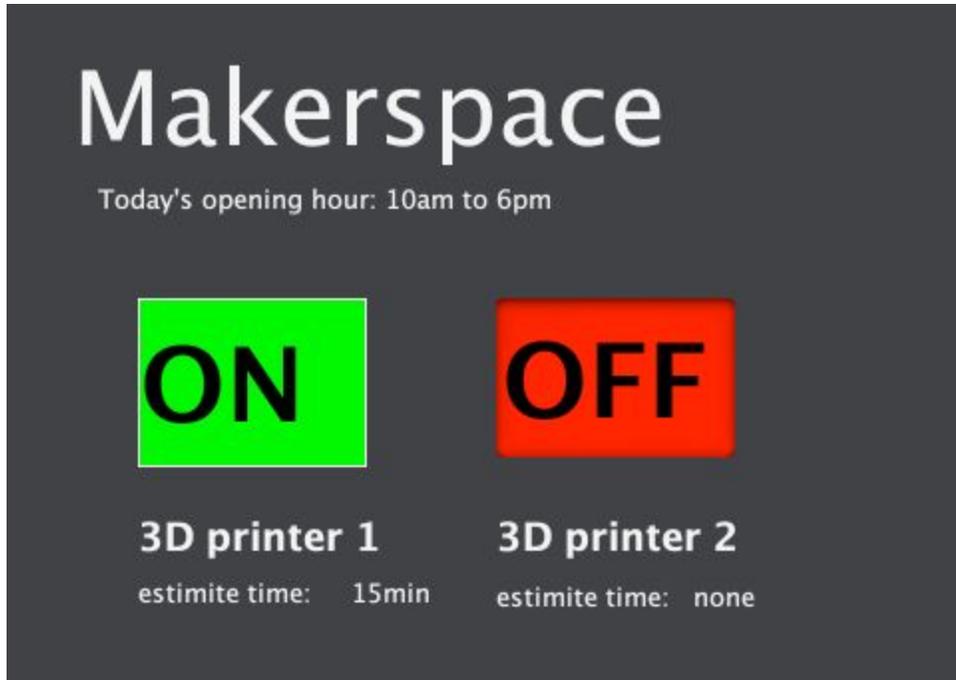
Figure 3 sample simple user interface

Solution 2- Editable user interface

      The user interface is developed based on a simple user interface. Some editable content such as the current user's name and the description of the printing is added to the dashboard. The users can click on a link near the state of the 3D printer. This will open a new custom panel that allows the user to enter their information.

      To the users, these editable content may be inessential and fussy. However, this function can help Makerspace to keep a digital record of who is using the 3D printer for what purpose.

      The following picture shows an example:
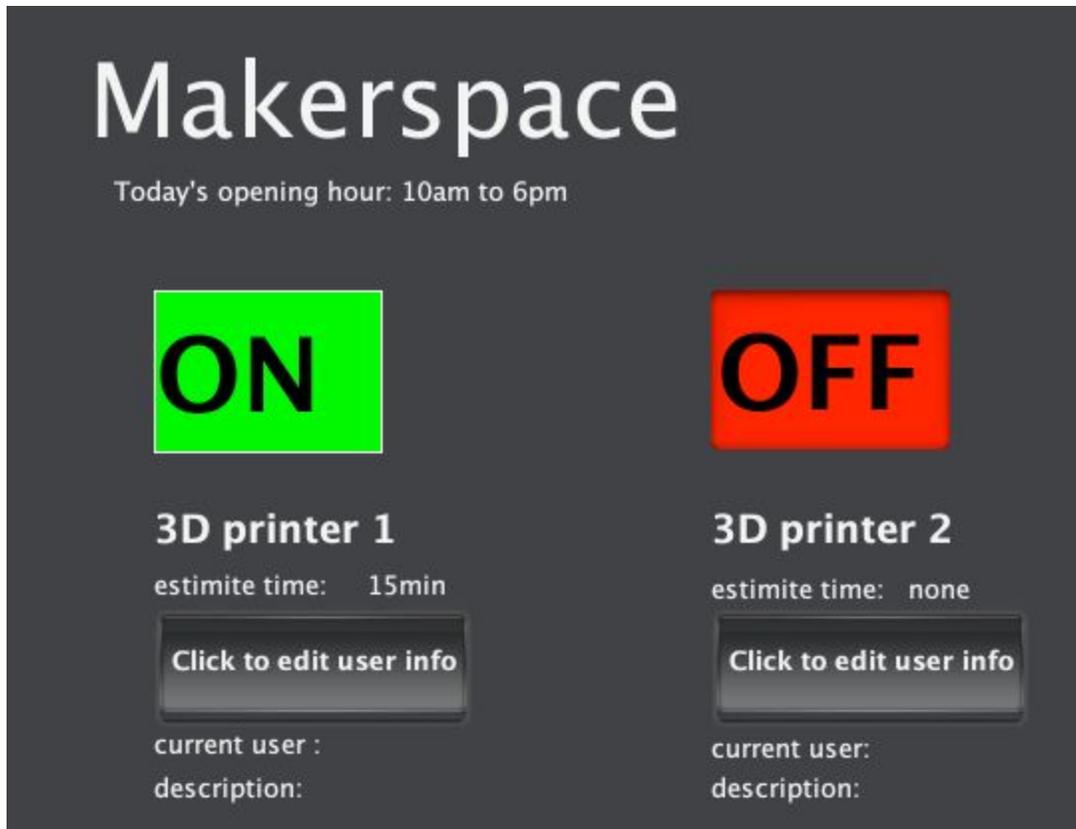
Figure 4 sample editable user interface

Solution 3- Live-time playing user interface

      The live-time playing user interface is the most accurate one because in this case, the user can get the information of 3D printers by watching the image captured by the camera. In the dashboard, customers can clearly see the different parts for different 3D printers, and in those parts, they will find the image for the corresponding 3D printer. The image would refresh every one minute to keep the information up-to-date.

      Live-time playing user interface can not only show people if 3D printers are working but also can show people how much time left for the printing.

      For a working 3D printer, it will show the image but for those which are not running, there will show nothing.

Integration of the sensor with the printer (By Kevin)

Based on research the design should satisfy the following functional needs:
- The printer can be used as usually
- Wires and cables are organized
- The sensor should be fixed in one position

Some of the non-functional needs are:
1. It should be compact
2. If it is outside the printer it should be aesthetically pleasing

Solution 1:

A small wooden or acrylic box that will contain the sensor. It will be placed right beside all the printers and students can tap their cards onto the box to begin the timer and then tap when done with their printer.

This will be efficient since it will require minimal effort by the users to begin the timer. If possible we could ensure that for the printer to start up the timer needs to be on so that the identity of every user can be known.


Figure 5: An example of the sensor in an acrylic cuboid

The wires can be directed through grooves at the back to connect to the 3D printer and to the main server which will keep track of all the sensors.

Solution 2:

A small camera can be mounted in the working area of each 3D printer. The camera should be able to capture a clear picture so as to show the identity of the current user. The camera will be programmed to either provide a live feed or periodically take pictures that will be sent back to the dashboard.

It would be best if the camera is away from the reach of the users to prevent tampering by users with ill intent.
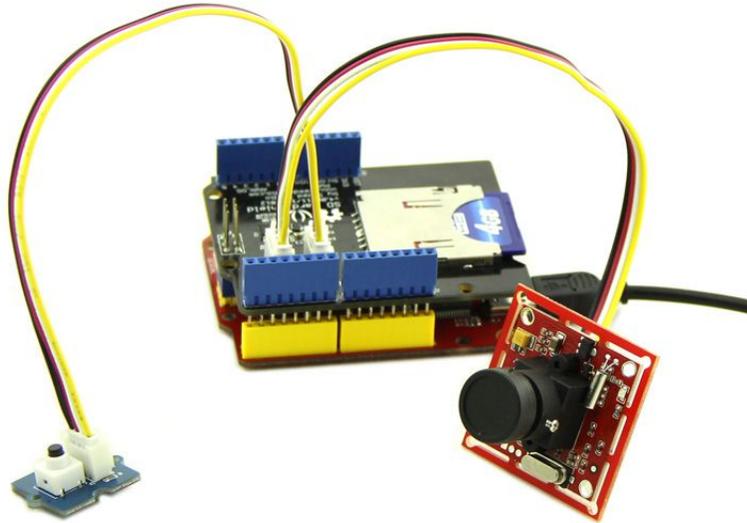
Figure 6: An example of one of the cameras to be used

Solution 3:

Rather than purchasing a box that fits all the components inside; instead 3D printing a container with the exact measurements needed would allow for the most compact orientation of the Arduino UNO board and all other components needed for the sensor. Additionally, this process would be free with the access to the Makerspace, since it allows students to print objects for free using PLA plastic. This material allows for the container to be manufactured and modified for an extremely low cost.

Conclusion:

This documentation is an organization of ideas from each group member which can be referred to through the design process for each member's input. For the remainder of the design process, the group will be able to take these ideas and include parts to develop an improved final product which addresses each of the needs of the customer.